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OVERVIEW

The **SALEM** *S*olid State *A*ll E*l*ectronic *E*nergy *M*eter is a complete tri-vector meter design for all three-phase power and energy measurement produces. This fully engineered SALEM is ready for production with the OEM doing only minor modifications.

SALEM enables harmonic analysis to be performed by multiplexed sequential sampling. Unlike microcontrollers, which cannot do harmonic analysis, SALEM performs phase voltage and line current harmonic analysis in software. SALEM's asynchronous interface enables communications with telephone modems for transmission over telephone or power lines or via RF.

The base configuration of SALEM is useful for a three-phase, three-wire operation, with nominal load current of five amperes per phase. The meter measures the line currents and phase voltages and computes active, re-active and apparent energy and power to an accuracy of Class 0.5. SALEM also computes power factor, frequency, the first, third and fifth harmonics of phase voltages and line currents.

HIGHLIGHTS

- **A complete engineered 3-phase, Tri-vector meter design**
- **Measures active, reactive and apparent energies**
- **Design using ADSST-EM-3xxx chipset and tested for EMI/EMC as per IEC-687 standard**
- **Multiplexed sampling using an 8-channel 12-bit ADC**
- **Delay Equalization on sequential sampled data in software**
- **Measurements displayed on a 6-digit, 7-segment LED display**
- **True RMS measurement of all phase voltages and line currents**
- **Harmonic analysis of phase voltages and line currents performed in software**
- **Class 0.5 accuracy for active and reactive energy and power measurement**
- **Class 0.5 accuracy maintained for non-sinusoidal and dynamic loads**
- **Computation of apparent energy and power**
- **Optically isolated asynchronous communication port**
- **Meter calibration and configuration via PC-based software**
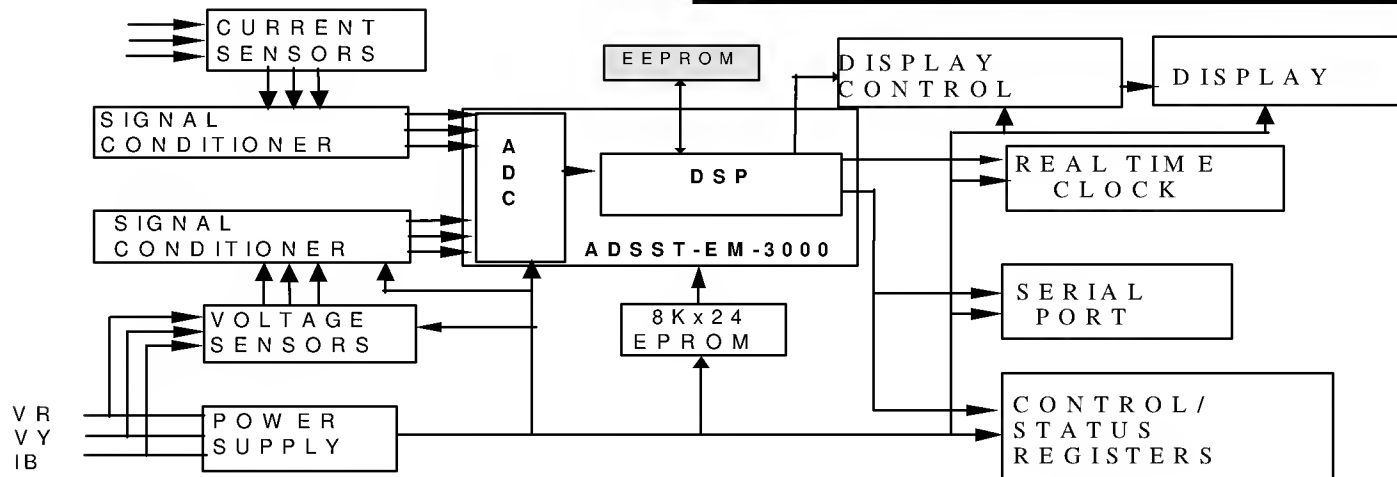
SALEM also may be configured to operate in a 3-phase, 4-wire mode. The required modifications are an addition of a current sensor, jumper changes on the PCB and re-configuration in the software. The computed maximum demand and time of day consumption and tamper proof data are stored in an EEPROM. For more specific information on these changes contact Analog Devices, Inc.

THEORY OF OPERATION

SALEM implements a three-watt meter method in four-wire configuration and two-watt meter method in three-wire configuration for measurement and computation of power and energy. SALEM consists of three basic sections:

- Signal conditioning and acquisition
- Digital Signal Processing and Storage
- Communication and Display

BASE CONFIGURATION:

- 3-phase 3-Wire, 5 Amps, computation of 15 parameters and storage of energies
- Configurable and expandable options: for 3-phase 4-Wire operation Tamper Proof Data for previous and current month
- Time of Day consumption of active, reactive and apparent energies with 6-programmable time slots per day
- Maximum and Cumulative demand data computation with 6 programmable time slots per day. Computes Rising Demand
- Integration period is programmable to 15 or 30 minutes for Maximum Demand computation

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SIGNAL CONDITIONING AND ACQUISITION:

A resistor divider scales down the phase voltages. The line currents are sensed using current sensors and are passed through the signal conditioning and automatic gain selection circuit to get the desired gain. The 8-channel, multiplexed sampling, 12-bit Analog-to-Digital converter, digitizes the signal conditioned current and voltage signals and sends the serial output data to the serial port of the Digital Signal Processor (DSP).

DIGITAL SIGNAL PROCESSING AND STORAGE

The ADSST-EM-3xxx consists of a DSP and a 12-bit Analog-to-Digital Converter. The DSP micro-computer is used for high speed numeric processing applications. SALEM software is stored in a 8Kx24 EPROM bank. The DSP stores the acquired current and voltage signals temporarily in the internal Data Memory for computation of following parameters:

- RMS values of all phase voltages and line currents
- Active, Reactive and Apparent Power and Energy
- Power Factor
- Maximum demand
- Frequency
- Magnitude and phase angle of the 1st, 3rd and the 5th harmonics of phase voltages and line currents

The EEPROM stores the active, reactive and apparent energies, Maximum Demand, Tamper Proof and Time of Day consumption data. The tamper proof data for the current and previous month contains following data for each phase voltage and line current:

- Number of failures
- Duration of failure
- First failure in that month
- Last restoration in that month

DISPLAY AND COMMUNICATION:

An eight-digit 7-segment LED display is used to display the fifteen basic computed parameters. Of these 8 digits, 6 digits are used for the display of parameters and 2 digits are used for parameter index. The DSP processor controls this display and all fifteen parameters are displayed in a cyclic fashion on the SALEM. A two-digit 7-segment display indicates the parameter that is being displayed. The on-board USART is configured for 8-bit character, no-parity and one stop bit operation and is interfaced to an opto-isolator. This enables SALEM to be connected to an RS-232 port of an external terminal for communication.

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SOFTWARE FEATURES

SALEM is a software based product and the unit can be interfaced to an IBM PC or compatible for calibration, configuration and monitoring. The meter does not use any trim potentiometers and calibration can be performed by software. Using the PC compatible software, the fifteen parameters can be enabled or disabled for display on the meter. The Current Transformer (CT) and Potential Transformer (PT) ratios can be changed, such that the displayed values will be the actual values fed to the CT and PT. The software allows a user to store the meter ID number. The magnitude and phase information of the 1st, 3rd and 5th harmonics of all current and voltage channels can be displayed on an external terminal using this software. SALEM uses a sequential sampling Analog-to-Digital converter and the delay in channel measurement is compensated by delay equalization software.

SPECIFICATIONS

NOMINAL CURRENT:

SALEM-5	5 Amperes per phase
SALEM-25	25 Amperes per phase

FREQUENCY:

Reference	50 Hz
Specified Range	40 - 150 Hz

VOLTAGE:

Reference	3X230 Volts
Specified Range	168 to 276 Volts
Measurement Accuracy	Class 0.5
Power Consumption	1.5 Watt per phase

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Analog Devices, Inc. together with *Signion Systems* are developing the most advanced software system solutions today for DSP driven power meters.

All designs using this software must use ADSST-EM-3xxx.

For more information on the DSP and ADC in this chipset, contact: *systems.solutions@analog.com*